

M. Harris

C & C TECHNOLOGIES, INC.



A TECHNICAL REPORT

on

PHASE 2: SEA LION CONFIGURATION

for

NRL CONTRACT N00014-94-C-6005

Approved for public release;
distribution is unlimited.

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GENERAL

Sea Lion #1 has been mechanically reconfigured and refurbished in order to make the vehicle sea worthy and capable of meeting NRL's needs as a research and development platform. The hull has been extended by 16 inches and the electronics bay modified to improve payload capacity. These modifications included the lowering of the fore planes and splitting the fuel into two compartments. The nose cone was also modified for easy access and removal for sensor installation and maintenance. Additional modifications were made to the hull to accommodate the Brooks Ocean launch and retrieval system.

Sea Lion #1 was also electrically refurbished in order to insure the vehicle is fully functional and operationally sound. Some sensors were upgraded and the entire electrical system checked, refurbished and calibrated.

MECHANICAL

The key points in the hull modification to the Sea Lions were, increasing the electronics payload capacity, extending mission endurance through added fuel capacity, and fitting for the Brooks Ocean launch and retrieval lifting points.

C & C Technologies in co-operation with GEO Resources engineered changes to the existing Sea Lion hull which were reviewed and approved by NRL. The Sea Lion's new mission parameters would require the removal, and fabrication of a redesigned forward hull section. The Sea Lions forward hull configuration had two major design deficiencies, a large but limited electronics space, with no heat sinking surfaces, and the forward dive planes and fuel tanks encompassing the entire hull, preventing forward extension of the electronics space. The new design divides the forward hull section horizontally with the upper half dedicated to electronics bay and lower section housing the fuel tanks and dive planes. (See Figure 1)

Upon design approval the hull was stripped of all electronic and hydraulic systems, engine removed for over haul and all subsystems removed for inspection and testing. The Sea Lion body was transported to Bollinger Ship Yard, Lockport Louisiana, where the hull was cut in half, 10.5" forward of the electronics bay/engine room bulkhead. A reconfigured section was rolled from 3/16" 6061 aluminum plate, cut to a length of 8'-1 1/2", and welded to the aft hull. The new section would house a 36 sq. ft. electronics bay, a net volume gain of 12.3 sq.ft. over the old Sea Lion's electronics bay. The new electronics bay has a drop step directly forward of the engine room/electronics bay bulkhead designed to house the existing Robertson SKR-82 Gyro Compass. The computer control box rests just above the gyro (See Figure 2). This location takes advantage of existing cable configurations and minimizes antenna cable lengths. A 5/8" thick aluminum floor plate 63" x 34" extends from this point forward to the ballast chamber bulkhead. This plate separates the fuel tanks from the electronics bay. It also functions as a heat sink for the electronics bay due to its large mass, and the under side is open to sea water through the fuel tanks. In the event of a hatch leak, a 2" wide drip tray surrounds the electronics bay floor

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A1	

for the water to pool. The drip tray routes water to the electronics bilge area which pumps into the engine room. (See figure 3)

The modifications to the forward hull section increased the vehicle length by 1'-4", to a total of 25'-4". These modifications and intended electronics payload shifted the theoretical center of gravity forward 10", now located 167" from the stern tube. To implement the Brooks Ocean launch and retrieval lifting davits, the snorkel mast was relocated forward of its old position and centered on the engine room/electronics bay bulkhead. Centering the mast on the bulkhead provided the necessary strength member for securing the forward lifting point. A second davit is incorporated on the aft engine room/ballast chamber bulkhead and protrudes through the sub's shell. The lifting points and dedicated lifting sling were certified at Bollinger ship yard to 1.5 times the gross vehicle weight of 7200 lbs. Sand bags and steel blocks were positioned in the sub to simulate the intended electronics payload not present at time of certification.

The fuel system is divided into two interconnected saddle tanks, bisected by the forward dive planes, each tank has a volume of approximately 8 cu.ft.. This provides a fuel capacity of 116 gallons, an increase of 14 gallons. The fuel is contained in water tight bladders mounted inside the saddle tanks. Each tank is open to sea water through penetrations in the hull, this configuration maintains head pressure on the fuel while the vehicle is submerged. The fuel bladders were manufactured by Western Trading Co. of Slidel, LA. The new bladders were installed in the Sea Lions using the existing hardware. A small fuel leak was detected (seepage). It was determined that the material on the new fuel bags did not allow a proper seal with the existing hardware. New hardware was fabricated with larger flanges, increased bolt hole pattern, embossed flanges, and O-rings. (See Figures 4,5 and 6)

Guide pins, dog assemblies, and gasket faces were added to the nose cone and forward edge of the new hull section, so that the nose can be removed as needed. Four cubic feet of syntactic foam was added to the nose cone for permanent buoyancy. This flotation gives a net buoyancy gain of 145 lbs. This was necessary to offset the forward movement of the center of gravity.

A hinged knuckle was incorporated into the snorkel mast 28" from the base of the mast. This knuckle allows the mast to be lowered while remaining secured to the vehicle during transportation. This eliminates the requirement to remove the mast for transportation. (See figure 7)

The engine cooling system was changed from the existing sea water intake system to a closed loop system featuring external keel coolers manufactured by Fernstrum Inc. of Menominee, Michigan. This closed system allows the vehicles engine and subsequent sub systems to be exercised out of the water for periods of up to 45 minutes without over heating. The Sabres header tank, water pump and plumbing hoses were changed to accommodate the new keel coolers.

With the removal of the 440 Hz alternator, a large area of the engine room bulkhead was left available. The air system for the vents and blow were relocated here for ease of maintenance.

Geo-Resources informed us that their Dolphins were experiencing problems with the exhaust system clapper valve spring failure. This was due to excessive heat in the exhaust system. We located ENGINEERED SPRING, an engineering firm specializing in spring design and production. Information supplied by CSS concerning exhaust system temperature along with sample springs currently used were sent to the firm. They engineered a spring that fits within the current valve housing and is rated at the present working temperatures experienced by the CSS Dolphins at significantly less cost. The cost for sixteen springs was \$476.96, or \$29.81 each. The original manufacturers price was quoted at \$184.14 each.

ELECTRICAL

Very few changes were necessary during the electrical refurbishment. The attitude sensor was replaced because the mean time between failure was about 500 hours. A Watson Industries, Inc., ADS-C232-1A, Displacement/Rate Sensor replaced the old attitude sensor. The new sensor has a mean time between failure rate in excess of 50,000 hours. (See schematic at figure 8).

C & C Technologies engineered and built a belly pack for the Sea Lion. The belly Pack is necessary for safe maneuvering of the vehicle during launch and recovery operations. (See schematic at figure 9).

A relay was added to the control circuitry to turn the strobe light on and off. Software provisions were available but no control circuitry existed to implement the software commands for strobe on and off. (See schematic at figure 10).

EQUIPMENT REQUIRING REPLACEMENT

ENGINE

Spare parts for the Sabre engine currently in the Sea Lion are no longer available in the United States. All spares must come from the United Kingdom. This significantly increases the lead time and cost of spare or replacement cost. Additionally, when the supply of spares remaining in the United Kingdom are exhausted there will be no spares available. There are some companies working on developing after market parts. We do not recommend the use of these after market parts because of quality and fit. The following price comparisons are provided for your information.

SABRE

671 GM

<u>PART</u>	<u>COST</u>	<u>LEAD TIME</u>	<u>COST</u>	<u>LEAD TIME</u>
head gasket	\$152	10 days	\$47	none/same day
rings	\$437	10 days	\$257	next day
water pump	\$201	21 days	\$142	on hand

The cost of a new engine is approximately \$11,500.00, as quoted for a Detroit Diesel 4-53T. This engine meets the horse power, fuel economy and size requirements of the Sea Lion.

CONTROL ELECTRONICS/SOFTWARE

Logistical support for the existing electronic control system is very difficult. The software is written specifically to address boards that are no longer manufactured. Refurbished parts were located and procured to bring the Sea Lion to operational status. However, the availability of compatible hardware is very questionable in the near future. The control software is not portable to computer hardware currently produced.

The Sun workstation that will be installed in the Sea Lion to integrate and control the sensors and telemetry systems could also handle the vehicle control functions. Software can be developed to work on the topside Sun workstation for vehicle control. This would increase the electronics payload capacity by eliminating much of the hardware required on the vessel. This would also have the added benefit of readily available spares, (off the shelf), and access to source code.

PART SOURCE: See attachment 1.

ENGINE PARTS REPLACED: See attachment 2.

RECOMMENDED SPARE PARTS LIST: See attachment 3.

PART SOURCE

<u>PART NAME</u>	<u>PRICE</u>	<u>SOURCE</u>
DIVE PLANE BUMPERS	\$75.00 each	AMERICAN MOLD SERVICES 440 Industrial Parkway, Unit 8 Lafayette, Louisiana 70503-3365 Ph# (318) 233-6565 800-787-6653 Contact; Clement J. Cornay
HULL MODIFICATION		BOLLINGER SHIP YARD P.O. Box 250 Lockport, Louisiana 70374-0250 Ph# (504) 532-2554 Contact; Cliff Bonvillan
HIGH PRESSURE HYDRAULIC FILTERS original Pall filter #HH9021A12UPSWB Replacement Filter Part# PX 921-B3	\$110.00 each	PX FILTRATION 1004 Business Pkwy Dallas, Texas 75084 Ph# (214) 470-9894
*LOCAL DISTRIBUTER		CRANFORD EQUIPMENT S.E. Evangeline Thrwy Broussard, Louisiana Ph# (318) 837-1871
EXHAUST CLAPPER SPRINGS	\$25.00 each	ENGINEERED SPRINGS 9881 Tanner Road Houston, Texas 77041 Ph# (713) 690-0391 Contact; Tom Upton

ALTERNATOR REPAIR

HAROLD & CASTIEL
Admiral Doyal
New Iberia, Louisiana
Ph# (318) 364-8248

NEW ELECTRODYNE ALTERNATOR
model # GE100-24LCM \$1300.00 each

ELECTRODYNE, INC.
Pleasant Hill Road
Scarborough, ME 04074
Ph# (207) 883-4121
800-341-0242

ORCA PARTS

I.S.E. RESEARCH
1734 Bradway Street
Port Coquitlam, B.C. Canada
U3C 2M8
Ph# (604) 942-5223

KEEL COOLERS \$3400.00 each

R.W. FERNSTRUM, INC.
Menominee, Mich 49858
Ph# (318) 365-3679

*LOCAL DISTRIBUTOR

MID-SOUTH BOAT
2804 East Hwy. 90
New Iberia, Louisiana 70560
Ph# (318) 365-3679

SABRE ENGINE PARTS

NORTHEAST FORD ENGINE
56 Mitchel Road
Ipswich, Maine 01938
Ph# (508) 356-2114
Contact; Chip

FUEL CELLS (bags only) \$550.00 set (2)

WESTERN TRADING CO.
Slidel, Louisiana (plant)
Ph# (504) 343-1222
Contact; Steve Gauthreaux

ATTITUDE SENSORS \$2480.00 each WATSON INDUSTRIES, INC.
p/n # ADS C232-1A 3041 Melby Road
Eau Claire, WI 54703
Ph# (715) 839- 0628

SYNTACTIC FOAM, type2 \$175.00 per cu. ft.
(4 cu. ft. per sub) FLOATATION TECHNOLOGIES
P.O. Box 1171
Biddeford, ME 04005
Ph# (207) 282-7749

DATA RADIOS/MODEMS \$5050.00 each DATA RADIO, INC.
p/n # DR 4800B2 (U.S.) 5500 Royalmount, #200
Montreal, Canada H4P 1H7
Ph# (514) 737-0020

DEPTH SENSORS \$660.00 each DATA INSTRUMENTS
p/n #BF, 15 psia, 24vdc 100 Discovery Way
Acton, MA. 01720
Ph# (508) 264-9550

OVER DEPTH SWITCH (2 part) \$104.00 each ASCO SWITCH
comutator switch #PA31A 50-60 Hanover
replacement #PA31B Florhan Park, N.J. 07932
Ph# (201) 966-2000

PRESSURE SWITCH # RE 30A44 \$98.50 each

*LOCAL ASCO DISTRIBUTOR MOODY PRICE
Baton Rouge, Louisiana
Ph # (504) 344-0511

BALLAST BLOW SOLENOID/VALVE \$246.00 each ASCO SWITCH
p/n #8211 C11 50-60 Hanover
replacement # EF 8210G11 Florhan Park, N.J. 07932
Ph# (201) 966-2000

MAST SOLENOID, model # SDG \$180.00 each
p/n # SA-1834-24

SYNCHRO START, INC.
6250 W. Howard
St. Niles, ILL. 60642
Ph# (708) 967-7730

THROTTLE SOLENOID, model # 1504
p/n # 24C6U1B281 \$45.50 each

SYNCHRO START
6250 W. Howard
St. Niles, ILL. 60642
Ph# (708) 967-7730

10 A CIRCUIT BREAKER \$4.90 each
p/n # 30055-10

COLE HERSEE
20 Old Colony Ave.
South Boston, MA. 02127
Ph# (617) 268-2100

*LOCAL DISTRIBUTOR

GUIDRY'S IGNITION SERVICE
New Iberia, Louisiana
Ph# (318) 365-7471

PRESSURE SENDING UNITS \$225.00 each
p/n # PX303-2KG5V

OMEGA ENGINEERING
One Omega Dr., Box 4047
Stamford, CT. 06907
Ph# (203) 359-7874

ELECTRICAL CONNECTORS \$400.00 each
p/n # 5507-3221-0004

BURTON, INC.
111 Maryland St.
El Segundo, CA. 90245
Ph# (310) 322-0615

D.C. AMP METER \$275.00 each
p/n# IA 5025P

F.W. BELL , INC.
6120 Hanging Moss Rd.
Orlando, FL. 32807
Ph# (407) 678-690

HYDRAULIC FITTINGS & HOSES

3/16" fitting #3908-03544	\$31.00 each
3/8" fitting #3908-06548	\$71.00 each
3/16" hose @	\$1.12 ft.
3/8" hose @	\$2.40 ft.

SYNFLEX

10585 Main St.
Mantua, OH. 44255
Ph# 1-800-837-1467

*LOCAL DISTRIBUTOR

AL GEORGE, INC.
HWY. 90 E.
Lafayette, Louisiana
Ph# (318) 233-0626

HYDRAULIC PUMP

p/n # PV 86 RSY 20 CV1

\$740.00

SPERRY/VICKERS

5353 Highland Dr.
Jackson, Miss. 39206
Ph # (601) 981-2811

ENGINE PARTS REPLACED

SOURCE- NORTHEAST FORD ENGINES, INC.
(508)356-2114

PART #/DESCRIPTION	QTY
66890-HUB	1
49038-PUMP-WATER	1
36240-SENDER	1
36252-GAUGE	1
66891-PULLEY-SPLIT	2
57259-BOLT	4
59010-WASHER	4
49038-PUMP-WATER	1
50031-GASKET	1
11130-SCREW-SET	5
59004-WASHER	5
58105-SCREW-SET	3
59003-WASHER	3
14050-HOUSING	1
15480-PIPE	1
15372-PIPE	1

attachment 2

50030-GASKER-THERMOSTAT	1
66894-PULLEY	1
58049-SCREW	3
40169-BELT	3
15482-PIPE	1
40505-SWITCH	1
11710-CAP-7 PSI	1
50130-GASKET CAP	1
59061-WASHER- 3/8	3
57374-BOLT- 3/8	1
16127-HOSE- REDUCER	1
16120-HOSE	1
16165-HOSE	1
16123-HOSE	1
16153-HOSE	1
13745-HOSE-END	2
13746-HOSE- BRAIDED	1
13084-ADAPTER	1
10072-TANK-HEADER	1
59002-WASHER-8MM	2
58065-SCREW-SET	2
12114-BRACKET	1

57254-SCREW-SET	2
57257-SCREW-SET	1
12113-BRACKET	1
65074-SCREW	4
59060-WASHER	4
66892-SPACER	10
31000-HOSE-5/16 ID PVC	1
15395-CLIP	1
57252-SCREW-SET	1
55232-NUT	1
59060-WASHER	5
57259-BOLT	3
55381-NUT	2
59061-WASHER-3/8	4
57357-SCREW-SET	2
59010-WASHER	6
66719-O-RING	1
194-155-SERVICE MANUAL	2

drive belts # V80, 13C 1815 A69 Matched set (Gates)

VEHICLE BODY

lifting sling w/shackles
nose cone gaskets
electronics bay gasket
engine room gasket
silicone grease to lubricate gaskets
s.s. hatch dog bolts
with spacers, nuts, and rollpins
Spare mast
O-rings for knuckle, Parker # 256
mast fairing
upper mast covers
forestay with fairing
spare dive planes-forward & aft
dive plane bumpers
spare rudder
propellers
propeller shaft
exhaust pipe cowlings
sump cover
stuffing box

MISC

contact cleaner
electrical insulating grease
silicone sealant
Loctite 515 gasket eliminator
assorted stainless hardware
Helicoil thread repair kits
cable termination supplies
Scotch coat
Scotch 33 electrical tape
Scotch 133 splicing tape
assorted heat shrink
heat gun
potting compound
100-300 watt soldering gun
20- 50 watt soldering iron

HYDRAULICS AND AIR SYSTEM

hydraulic pump, part # PV 86 RSY 20 CV1 (Vickers)
3/8 Synflex hose
3/8 Synflex female reusable fittings
3/16 Synflex female reusable fittings
3/16 Synflex female reusable fittings
High pressure oil filter, part # px 921-A3 (PX Filtration)
Bank valve solenoids, part # 211-157, (Atchey Controls)
Bank control valve, part # DG4V3 6C WH12, p/n 468483 (Vickers)
hydraulic cylinder, complete
55 gallons hydraulic oil
air vent body gaskets (I.S.E.)
high pressure air feedback sensor (Omega)
low pressure air feedback sensor (Omega)
spare gauges, 0-500 psi., 0-5000 psi.
O-ring kit
O-ring splicing kit
assorted JIC fittings
assorted pushlock fittings
assorted JIC plugs & caps
teflon tape
oil absorbent pads
clean box of rags

ELECTRICAL

depth sensor	# BF ,range 15 psia, 24 vdc (Data Instruments)
over depth switch,	# PA31A (ASCO Switch)
DC current sensor	# IA 5025P (F.W. Bell)
circuit breakers	# 30055-10 (Cole Hersee)
mast valve solenoid	# SDG, part # 24C6U1B281, 24vdc (Syncro Start)
throttle solenoid	# SDG, part # SA-1834-24, 24vdc (Syncro Start)
hall effect sensors,	
magnet assemblies	(I.S.E.)
gyro boards	(Robertson)
set of connectors	
antennas w/cables,	

ELECTRONICS

Spares List

Description	Manufacturer	Part Number	Quantity	Source
Computer Equipment				
Computer Board	MPL AG	MPL 4220-1-96	1	Gespac
Computer Board	Gespac	GESADA-1A	1	Gespac
Computer Board	Gespac	GESMPU-14	1	Gespac
Computer Board	MPL AG	MPL 4205-1-96	1	Gespac
Computer Board	Gespac	GESMEM-12BC	1	Gespac
Computer Board	Gespac	GESICC-1S	1	Gespac
Computer Board	Gespac	GESCIO-1B	1	Gespac
Computer Board	Gespac	GESPIA-2A	1	Gespac
Computer Board	Gespac	GESICU-2A	1	Gespac
Data Acquisition Board	Data Translations	DT28081	1	Data Translations
Video Driver Board	AST Research	AST-3G Plus	2	PC Service Source
RAM Board	AST Research	P286 FASTRAM	2	PC Service Source

Mother Board	AST Research	P286 Main	1	PC Service Source
Data Acquisition Board	Scientific Solutions	Base Board - 200025	1	JACO Electronics
EPROM	AMD	AM27C256-150 DC	6	Newark Electronics
EPROM	AMD	AM27C128-150 DC	4	Newark Electronics
RAM	Motorola	MCM6206DP20	8	Newark Electronics

Power Supplies				
DC - DC Converter	Vicor	VI-210-CW	1	Vicor
DC - DC Converter	Vicor	VI-B10-CW	1	Vicor
DC - DC Converter	Vicor	VI-211-CX	2	Vicor
DC - DC Converter	Vicor	VI-2W2-CV	1	Vicor
DC - DC Converter	Vicor	VI-213-CW	1	Vicor
Converter Filter	Vicor	VI-RAM-C1	1	Vicor
Computer Power Supply	Kepco	RDT 001-AA-24	1	Data Marketing
HV Power Supply	Ultravolt	1/8 A24-P20-C	1	Ultravolt
Relays				
Time Delay Relay	Potter & Brumfield	CHD-38-30011	1	Newark Electronics
Control Relay	Potter & Brumfield	KRPA 11 DG24	2	Newark Electronics
Time Delay Relay	Potter & Brumfield	CDD-38-30012	1	Newark Electronics
DC Power Relay	Stancor	70-903	2	Newark Electronics
Control Relay	T-Bar	801-12C12	1	Newark Electronics
Operators Control Console				
Monitor - EGA/CGA	Princeton	HX12E	1	Ultimate Display

Keyboard	Cherry Electrical	G81-1800-HAU / 06	1	Carlton - Bates
Joystick	Maurey Instruments	SAJ-2723-1CS-502	1	Maurey Instruments
Switch	Allen-Bradley	800H-JR2A	1	Allen-Bradley
Potentiometer	Allen-Bradley	800H-UR29	1	Allen-Bradley
Switch	Allen-Bradley	800H-JR91	1	Allen-Bradley
Switch	Augat	MTL 106D	1	Newark Electronics
Switch	Augat	MTL 206P	1	Newark Electronics
Switch	EAO Switch	31-121-025	2	Newark Electronics
Indicator	EAO Switch	31-040-005	1	Newark Electronics
Radio Equipment				
Arlan 620	Telesystems	200-000787	1	Telesystems SLW
HyperAmp 900	HyperLink Tech.	HyperAmp 900-X	1	HyperLink Tech.
Arlan Antenna	Maxrad	MFB-9387	1	Eagle Electronics
GPS Receiver	Trimble Navigation	24847-00	1	Trimble Navigation
Compact Dome Ant.	Trimble Navigation	16741-00	1	Trimble Navigation
Dataradio Antenna	Maxrad	MFB-4205	1	Eagle Electronics

Connectors				
Underwater	Marshall	26-5MC62	3	Fowler Resources
Underwater	Marshall	26-5FC62	3	Fowler Resources
Underwater	Marshall	46-5MC	3	Fowler Resources
Underwater	Marshall	46-5FC	3	Fowler Resources
Underwater	Marshall	46-5MCO	3	Fowler Resources
Underwater	Marshall	46-5FCO	3	Fowler Resources
Underwater	Marshall	66-5MC	3	Fowler Resources
Underwater	Marshall	66-5FC	3	Fowler Resources
Underwater	Marshall	86-5MC	3	Fowler Resources
Underwater	Marshall	86-5FC	3	Fowler Resources
Ribbon Cable	3M	3425-6000	2	Newark Electronics
Ribbon Cable	3M	3417-6000	4	Newark Electronics
Ribbon Cable	3M	3473-6000	4	Newark Electronics
Ribbon Cable	3M	3399-6000	4	Newark Electronics
Ribbon Cable	3M	3421-6000	4	Newark Electronics
Ribbon Cable	3M	3414-6000	2	Newark Electronics
Underwater	Burton	5501-3221-0015	2	Burton Elect. Eng.
Circular	Amphenol	MS3102A20-33S	1	Newark Electronics

Circular	Amphenol	MS3102A14S-05S	1	"
Circular	Amphenol	MS3102A18-19S	1	"
Circular	Amphenol	MS3102A18-12S	1	"
Circular	Amphenol	MS3106A20-33P	1	"
Circular	Amphenol	MS3106A14S-05P	1	"
Circular	Amphenol	MS3106A18-19P	1	"
Circular	Amphenol	MS3106A18-12P	1	"

Spares List

Description	Manufacturer	Part Number	Quant.	Unit \$	Total \$
Computer Equipment					
Computer Board	MPL AG	MPL 4220-1-96	1	895.00	895.00
Computer Board	Gespac	GESADA-1A	1	925.00	925.00
Computer Board	Gespac	GESMPU-14	1	895.00	895.00
Computer Board	MPL AG	MPL 4205-1-96	1	595.00	595.00
Computer Board	Gespac	GESMEM-12BC	1	425.00	425.00
Computer Board	Gespac	GESICC-1S	1	895.00	895.00
Computer Board	Gespac	GESCIO-1B	1	435.00	435.00
Computer Board	Gespac	GESPIA-2A	1	225.00	225.00
Computer Board	Gespac	GESICU-2A	1	175.00	175.00
Data Acquisition Board	Data Translations	DT2808	1	895.00	895.00
Video Driver Board	AST Research	AST-3G Plus	2	147.00	294.00
RAM Board	AST Research	P286 FASTRAM	2	160.00	320.00
Mother Board	AST Research	P286 Main	1	80.00	80.00
Data Acquisition Board	Scientific Solutions	Base Board - 200025	1	345.00	345.00
EPROM	AMD	AM27C256-150 DC	6	5.00	30.00
EPROM	AMD	AM27C128-150 DC	4	4.94	19.76
RAM	Motorola	MCM6206DP20	8	10.20	81.60
					0.00

Power Supplies					
DC - DC Converter	Vicor	VI-210-CW	1	160.00	160.00
DC - DC Converter	Vicor	VI-B10-CW	1	144.00	144.00
DC - DC Converter	Vicor	VI-211-CX	2	149.00	298.00
DC - DC Converter	Vicor	VI-2W2-CV	1	205.00	205.00
DC - DC Converter	Vicor	VI-213-CW	1	160.00	160.00
Converter Filter	Vicor	VI-RAM-C1	1	59.00	59.00
Computer Power Supply	Kepco	RDT 001-AA-24	1	534.00	534.00
HV Power Supply	Ultravolt	1/8 A24-P20-C	1	295.00	295.00
					0.00
Relays					
Time Delay Relay	Potter & Brumfield	CHD-38-30011	1	76.60	76.60
Control Relay	Potter & Brumfield	KRPA 11 DG24	2	17.40	34.80
Time Delay Relay	Potter & Brumfield	CDD-38-30012	1	116.50	116.50
DC Power Relay	Stancor	70-903	2	22.20	44.40
Control Relay	T-Bar	801-12C12	1	116.13	116.13
					0.00
Operators Control Console					
Monitor - EGA/CGA	Princeton	HX12E	1	375.00	375.00
Keyboard	Cherry Electrical	G81-1800-HAU / 06	1	62.95	62.95
Joystick	Maurey Instruments	SAJ-2723-1CS-502	1	109.53	109.53
Switch	Allen-Bradley	800H-JR2A	1	28.84	28.84

Potentiometer	Allen-Bradley	800H-UR29	1	118.00	118.00
Switch	Allen-Bradley	800H-JR91	1	37.49	37.49
Switch	Augat	MTL 106D	1	7.94	7.94
Switch	Augat	MTL 206P	1	10.79	10.79
Switch	EAO Switch	31-121-025	2	11.90	23.80
Indicator	EAO Switch	31-040-005	1	3.91	3.91
Radio Equipment					
Arlan 620	Telesystems	200-000787	1	2,500.00	2,500.00
HyperAmp 900	HyperLink Tech.	HyperAmp 900-X	1	598.00	598.00
Arlan Antenna	Maxrad	MFB-9387	1	180.00	180.00
GPS Receiver	Trimble Navigation	24847-00	1	7,500.00	7,500.00
Compact Dome Ant.	Trimble Navigation	16741-00	1	795.00	795.00
Dataradio Antenna	Maxrad	MFB-4205	1	113.00	113.00
Connectors					
Underwater	Marshall	26-5MC62	2	15.00	30.00
Underwater	Marshall	26-5FC62	2	15.00	30.00
Underwater	Marshall	46-5MC	2	30.00	60.00
Underwater	Marshall	46-5FC	2	30.00	60.00
Underwater	Marshall	46-5MCO	2	28.00	56.00
Underwater	Marshall	46-5FCO	2	28.00	56.00
Underwater	Marshall	66-5MC	2	40.00	80.00
Underwater	Marshall	66-5FC	2	37.00	74.00

Underwater	Marshall	86-5MC	2	49.00	98.00
Underwater	Marshall	86-5FC	2	46.00	92.00
Ribbon Cable	3M	3425-6000	2	8.52	17.04
Ribbon Cable	3M	3417-6000	4	6.82	27.28
Ribbon Cable	3M	3473-6000	4	2.45	9.80
Ribbon Cable	3M	3399-6000	4	4.65	18.60
Ribbon Cable	3M	3421-6000	4	3.60	14.40
Ribbon Cable	3M	3414-6000	2	6.09	12.18
Underwater	Burton	5501-3221-0015	2		0.00
Circular	Amphenol	MS3102A20-33S	1	18.89	18.89
Circular	Amphenol	MS3102A14S-05S	1	10.15	10.15
Circular	Amphenol	MS3102A18-19S	1	15.21	15.21
Circular	Amphenol	MS3102A18-12S	1	12.88	12.88
Circular	Amphenol	MS3106A20-33P	1	28.33	28.33
Circular	Amphenol	MS3106A14S-05P	1	13.56	13.56
Circular	Amphenol	MS3106A18-19P	1	24.80	24.80
Circular	Amphenol	MS3106A18-12P	1	16.36	16.36
					0.00
				Total	11,427.52

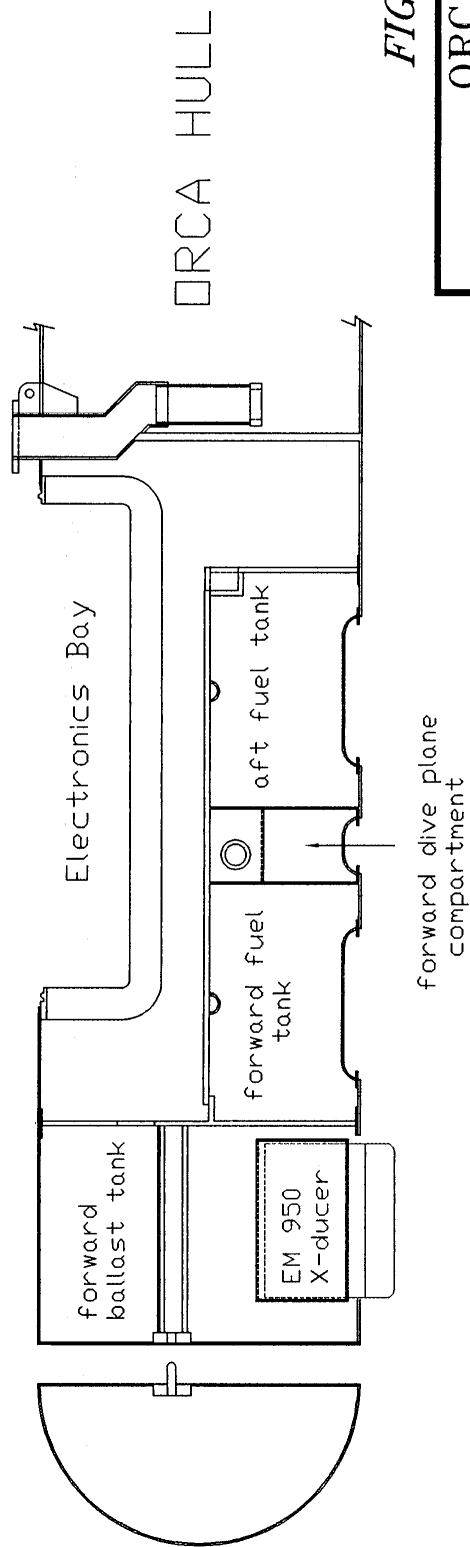
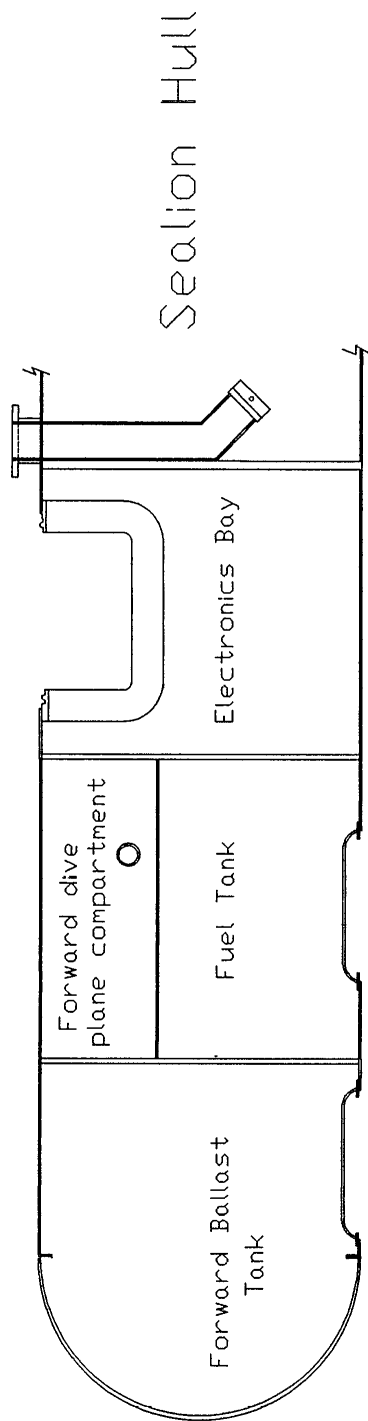
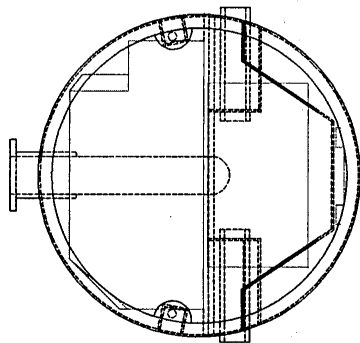
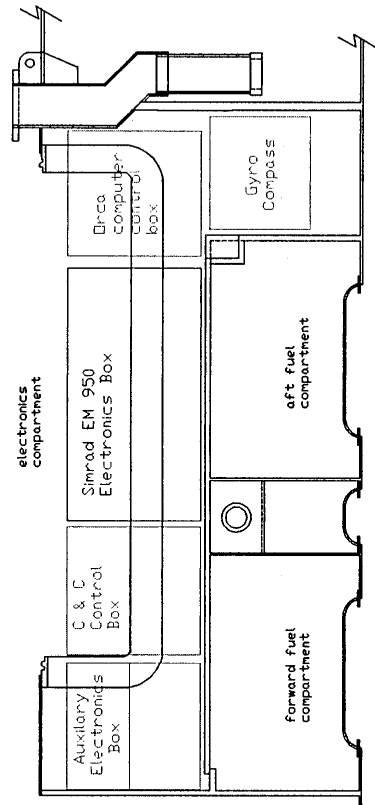


FIGURE 1

ORCA HULL MODIFICATIONS		NRL CONTRACT NO. N00014-94-C-6005	DATE: 10/12/94
HULL CONFIGURATIONS		Dwg: 2SUB	REV.
PREPARED BY: C & C TECHNOLOGIES, INC. 600 DOVER BLVD., LAFAYETTE, LA. (318) 981-1442			



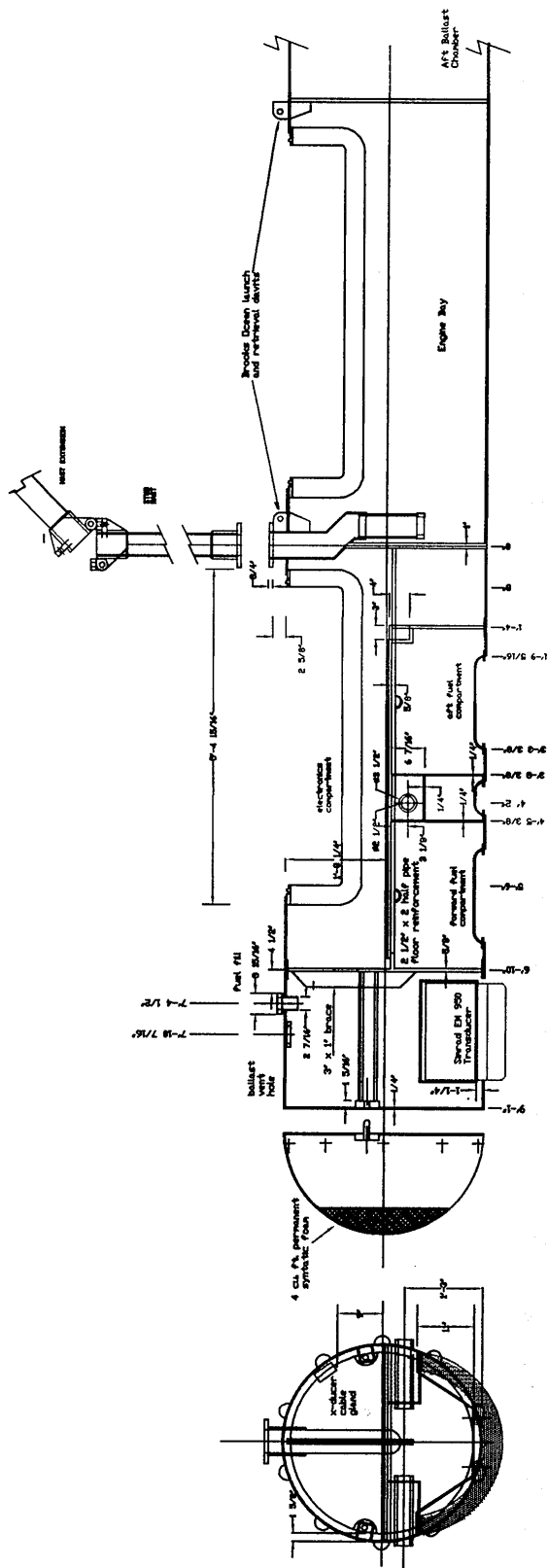
front view



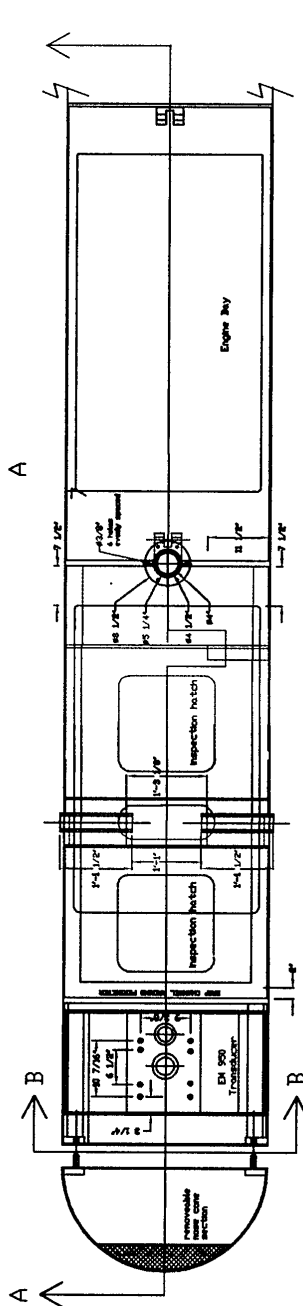
side view

FIGURE 2

ORCA HULL MODIFICATIONS		NRL CONTRACT NO. N00014-94-C-6005	DATE: 10/12/94
ELECTRONICS PAYLOAD		Dwg: PAYLOAD	REV.
PREPARED BY: C & C TECHNOLOGIES, INC. 500 DOVER BLVD., LAFAYETTE, LA. (318) 981-1442			



SECTION B-B

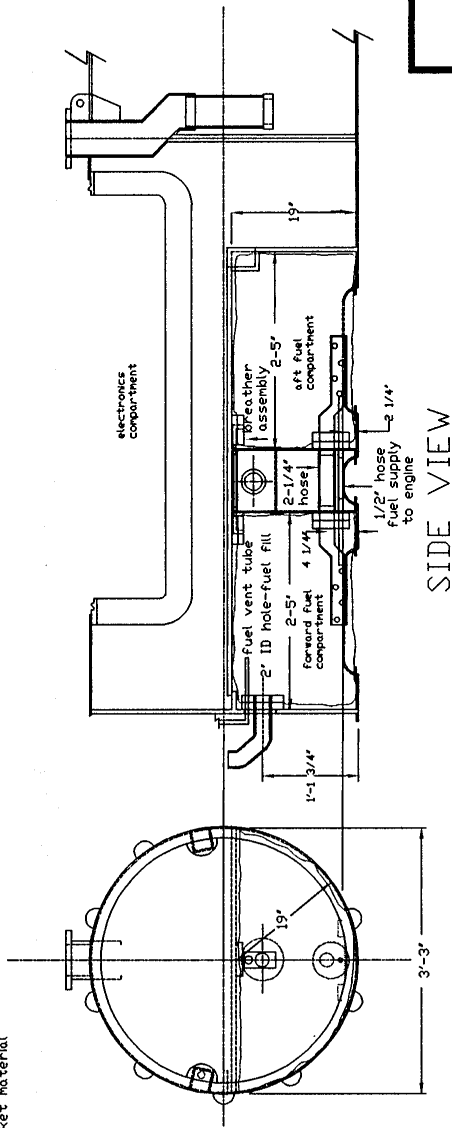
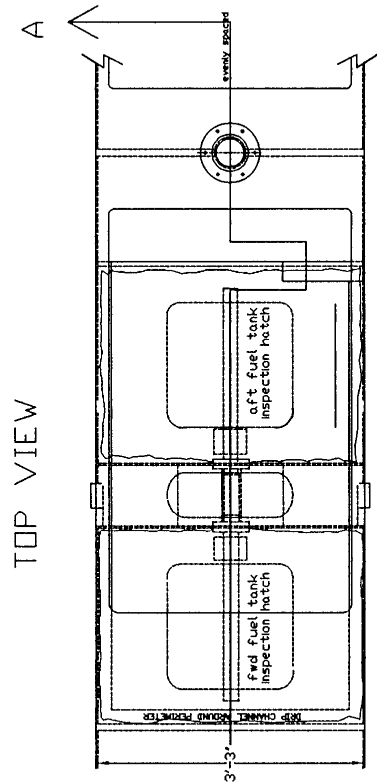
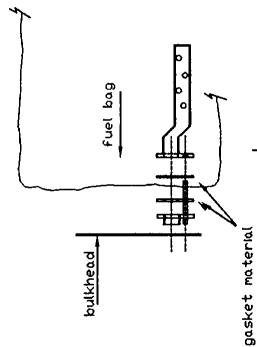
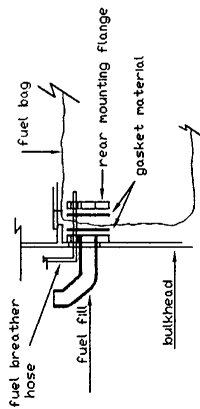


SECTION A-A

TOP VIEW

FIGURE 3

ORCA HULL CONFIGURATION	
ORCA HULL MODIFICATIONS	
PREPARED BY: C. E. FARRINGTON, INC. 400 S. W. 10TH AVE. (313) 581-1144	DATE: 10/12/84
REV. 1	REV. 1
REV. 2	REV. 2
REV. 3	REV. 3
REV. 4	REV. 4
REV. 5	REV. 5
REV. 6	REV. 6
REV. 7	REV. 7
REV. 8	REV. 8
REV. 9	REV. 9
REV. 10	REV. 10
REV. 11	REV. 11
REV. 12	REV. 12
REV. 13	REV. 13
REV. 14	REV. 14
REV. 15	REV. 15
REV. 16	REV. 16
REV. 17	REV. 17
REV. 18	REV. 18
REV. 19	REV. 19
REV. 20	REV. 20
REV. 21	REV. 21
REV. 22	REV. 22
REV. 23	REV. 23
REV. 24	REV. 24
REV. 25	REV. 25
REV. 26	REV. 26
REV. 27	REV. 27
REV. 28	REV. 28
REV. 29	REV. 29
REV. 30	REV. 30
REV. 31	REV. 31
REV. 32	REV. 32
REV. 33	REV. 33
REV. 34	REV. 34
REV. 35	REV. 35
REV. 36	REV. 36
REV. 37	REV. 37
REV. 38	REV. 38
REV. 39	REV. 39
REV. 40	REV. 40
REV. 41	REV. 41
REV. 42	REV. 42
REV. 43	REV. 43
REV. 44	REV. 44
REV. 45	REV. 45
REV. 46	REV. 46
REV. 47	REV. 47
REV. 48	REV. 48
REV. 49	REV. 49
REV. 50	REV. 50
REV. 51	REV. 51
REV. 52	REV. 52
REV. 53	REV. 53
REV. 54	REV. 54
REV. 55	REV. 55
REV. 56	REV. 56
REV. 57	REV. 57
REV. 58	REV. 58
REV. 59	REV. 59
REV. 60	REV. 60
REV. 61	REV. 61
REV. 62	REV. 62
REV. 63	REV. 63
REV. 64	REV. 64
REV. 65	REV. 65
REV. 66	REV. 66
REV. 67	REV. 67
REV. 68	REV. 68
REV. 69	REV. 69
REV. 70	REV. 70
REV. 71	REV. 71
REV. 72	REV. 72
REV. 73	REV. 73
REV. 74	REV. 74
REV. 75	REV. 75
REV. 76	REV. 76
REV. 77	REV. 77
REV. 78	REV. 78
REV. 79	REV. 79
REV. 80	REV. 80
REV. 81	REV. 81
REV. 82	REV. 82
REV. 83	REV. 83
REV. 84	REV. 84
REV. 85	REV. 85
REV. 86	REV. 86
REV. 87	REV. 87
REV. 88	REV. 88
REV. 89	REV. 89
REV. 90	REV. 90
REV. 91	REV. 91
REV. 92	REV. 92
REV. 93	REV. 93
REV. 94	REV. 94
REV. 95	REV. 95
REV. 96	REV. 96
REV. 97	REV. 97
REV. 98	REV. 98
REV. 99	REV. 99
REV. 100	REV. 100



END VIEW

FIGURE 4

ORCA HULL MODIFICATIONS

FUEL SYSTEM

PREPARED BY: C & C TECHNOLOGIES, INC. 500 DOVER BLVD., LAFAYETTE, LA. (318) 981-1442	NRL CONTRACT NO. N00014-94-C-6005	DATE: 10/12/94
	Dwg: FUEL	REV.

Female flange

Male flange

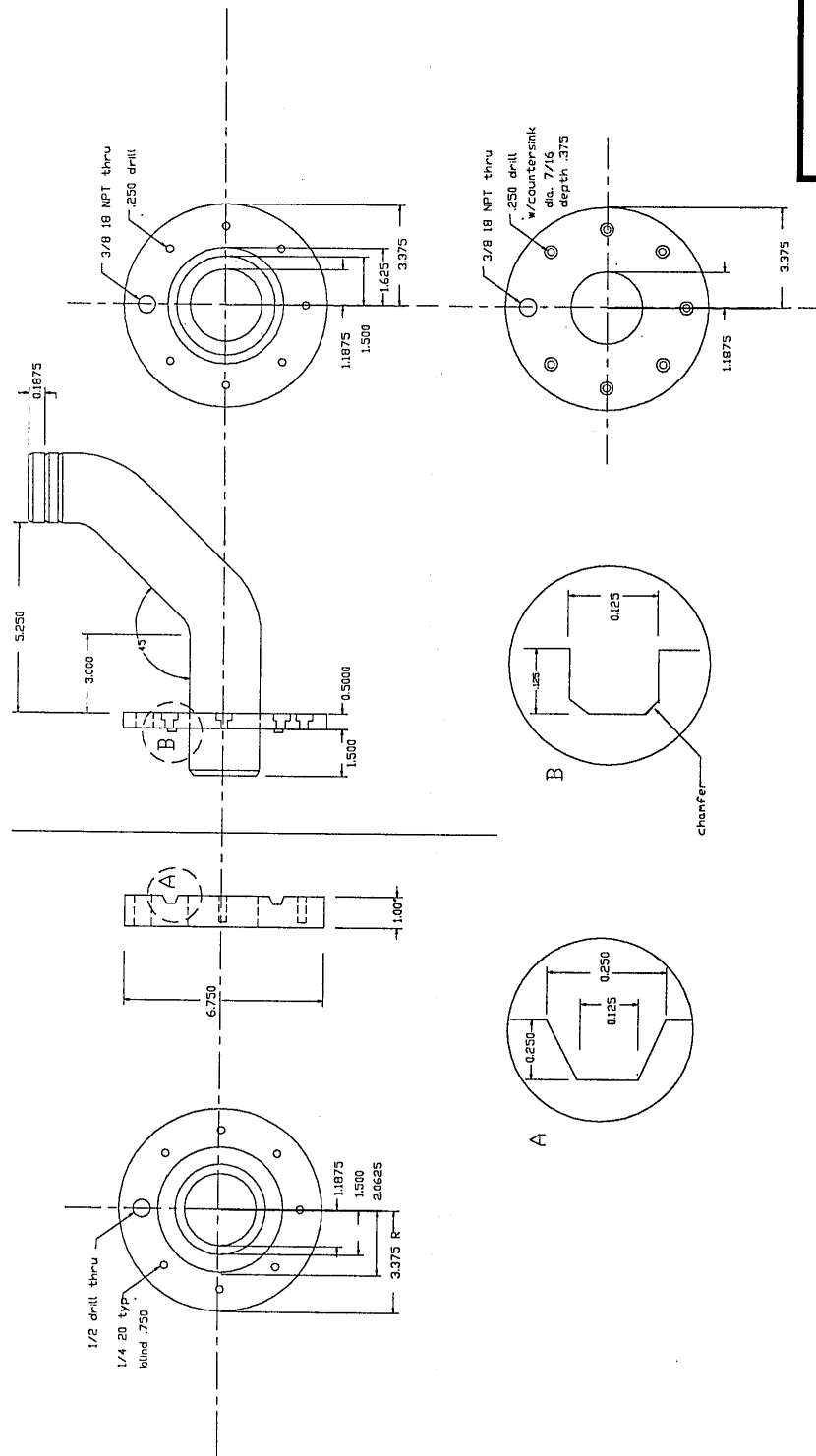


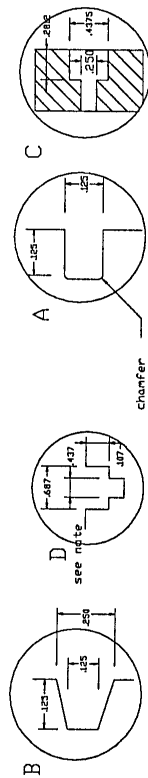
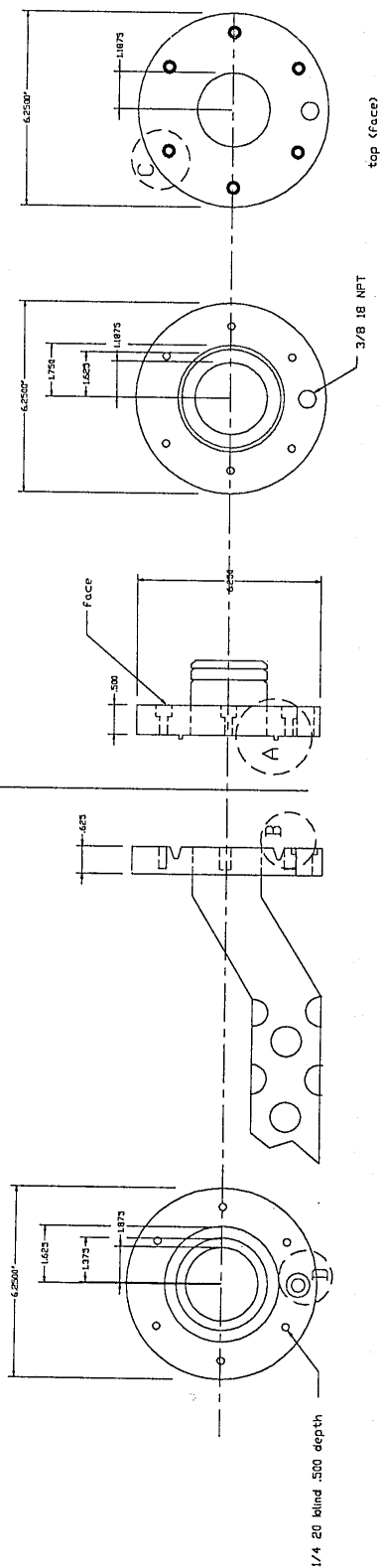
FIGURE 5

ORCA HULL MODIFICATIONS

FUEL CELL HARDWARE

PREPARED BY: C & C TECHNOLOGIES, INC. 500 DOVER BLVD., LAFAYETTE, LA. (318) 981-1442	NRL CONTRACT NO. N00014-94-C-5005	DATE: 10/12/94
	Dwg: FLANGE	REV.

Female flange | Male flange



Fuel Transfer System Notes (D) o-ring seat tolerances +/- .002
o-ring parker # 206 VITRON

FIGURE 6

ORCA HULL
MODIFICATIONS

FUEL TRANSFER HARDWARE

PREPARED BY: C & C TECHNOLOGIES, INC. 500 DOVER BLVD., LAFAYETTE, LA. (318) 981-1442	NRL CONTRACT NO. N00014-94-C-6005	DATE: 10/12/94
	Dwg: FUELTRAN	REV.

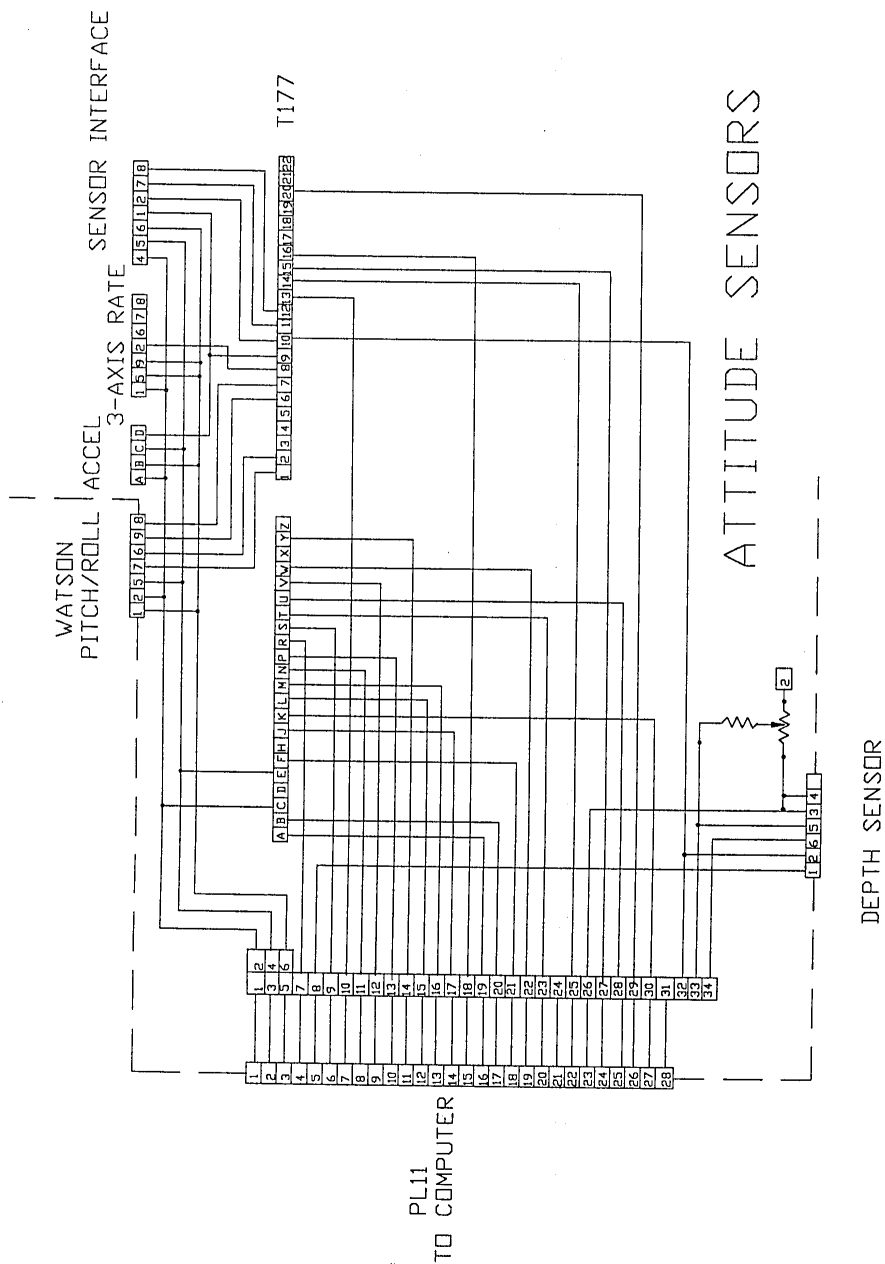


FIGURE 8

ORCA HULL MODIFICATIONS

ATTITUDE SENSORS

PREPARED BY:
C & C TECHNOLOGIES, INC.
500 DOVER BLVD., LAFAYETTE, LA.
(318) 981-4442

NRL CONTRACT NO.
N00014-94-C-6005
Dwg: SENSORS

DATE: 10/12/94
REV.

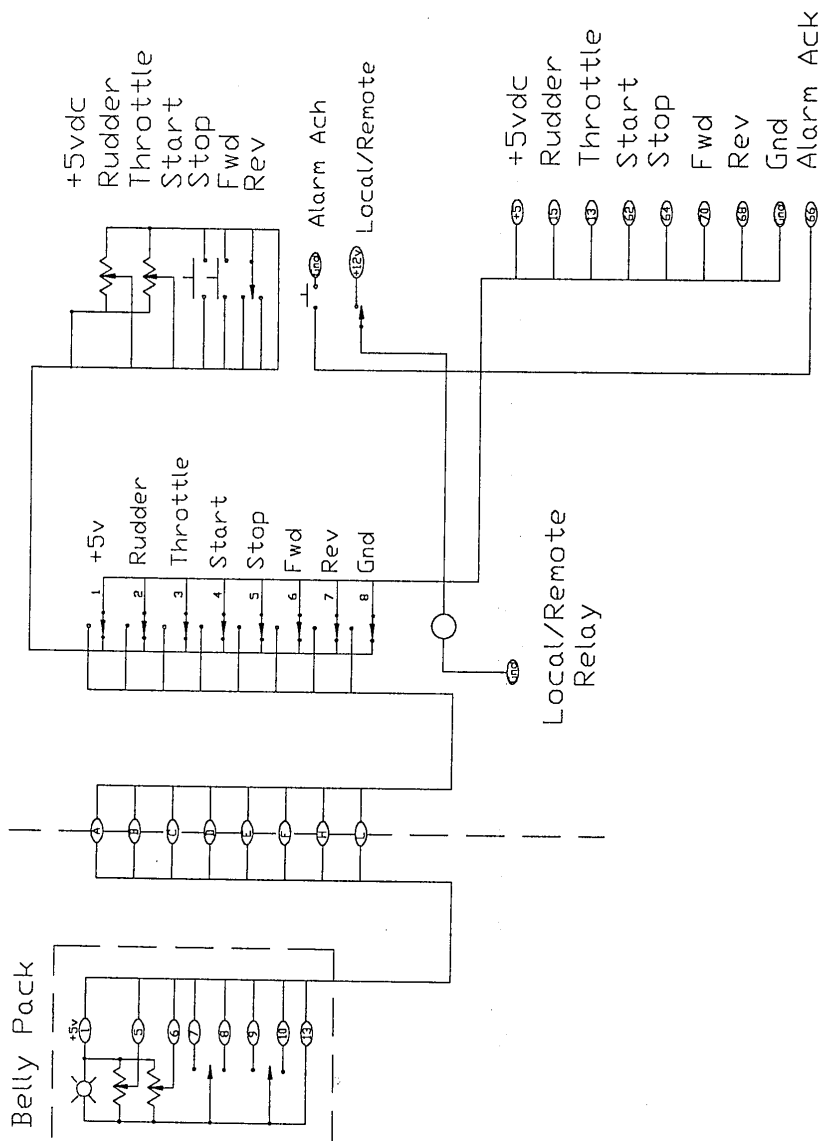


FIGURE 9

ORCA HULL MODIFICATIONS

BELLYPACK TIE-IN

PREPARED BY: C & C TECHNOLOGIES, INC. 500 DOVER BLVD., LAFAYETTE, LA. (510) 881-1442	NRL CONTRACT NO. N00014-94-C-6005	DATE: 10/12/94
	Dwg: BPACK	REV.

STROBE LIGHT

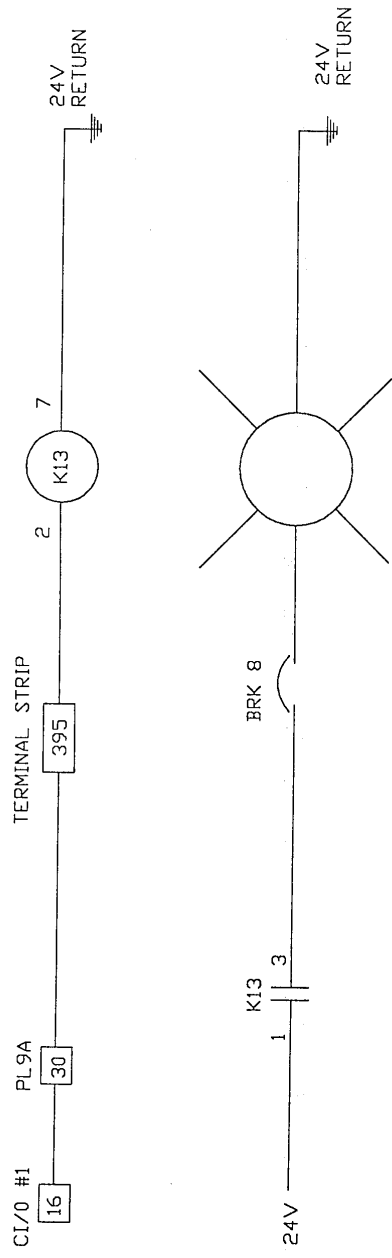


FIGURE 10

ORCA HULL MODIFICATIONS		NRL CONTRACT NO. N00014-94-C-6005	DATE: 10/12/94
STROBE LIGHT		Dwg: STROBE	REV.
PREPARED BY: C & C TECHNOLOGIES, INC. 500 DOVER BLVD., LAFAYETTE, LA. (318) 981-1442			

REPORT DOCUMENTATION PAGEForm Approved
OBM No. 0704-0188

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1. Agency Use Only (Leave blank).		2. Report Date. October 1994	3. Report Type and Dates Covered. Contract Report	
4. Title and Subtitle. A Technical Report on Phase 2: Sea Lion Configuration			5. Funding Numbers. Program Element No. 0603785N Project No. R1987 Contract No. N00014-94-C-6005 Accession No. DN252113 Work Unit No. 74-5137-A5	
6. Author(s).			8. Performing Organization Report Number.	
7. Performing Organization Name(s) and Address(es). C & C Technologies 500 Dover Blvd. Lafayette, LA 70503			10. Sponsoring/Monitoring Agency Report Number. NRL/CR/7440--95-0017	
9. Sponsoring/Monitoring Agency Name(s) and Address(es). Naval Research Laboratory Marine Geosciences Division Stennis Space Center, MS 39529-5004				
11. Supplementary Notes.				
12a. Distribution/Availability Statement. Approved for Public Release; Distribution is Unlimited.			12b. Distribution Code.	
13. Abstract (Maximum 200 words). Sea Lion #1 has been mechanically reconfigured and refurbished in order to make the vehicle sea worthy and capable of meeting NRL's needs as a research and development platform. The hull has been extended by 16 inches and the electronics bay modified to improve payload capacity. These modifications included the lowering of the fore planes and splitting the fuel into two compartments. The nose cone was also modified for easy access and removal for sensor installation and maintenance. Additional modifications were made to the hull to accommodate the Brooks Ocean launch and retrieval system. Sea Lion #1 was also electrically refurbished in order to insure the vehicle is fully functional and operationally sound. Some sensors were upgraded and the entire electrical system checked, refurbished and calibrated.				
14. Subject Terms. Autonomous; Vehicles; Sensors; Dolphin/EM100; Sea Lion; Multibeam Acoustic Sounding; Hydrographic Survey Sensor.			15. Number of Pages. 36	
			16. Price Code.	
17. Security Classification of Report. Unclassified	18. Security Classification of This Page. Unclassified	19. Security Classification of Abstract. Unclassified	20. Limitation of Abstract. SAR	